

***Testimony of Chris Gearhart, NREL Transportation and Hydrogen Systems Center Director, before U.S. Senate Committee on Energy and Natural Resources, January 21, 2016***

Chairman Murkowski, Ranking Member Cantwell, and members of this Committee, thank for this opportunity to speak with you today.

I am Chris Gearhart, Director of Transportation and Hydrogen Systems Research at the National Renewable Energy Laboratory. Prior to coming to NREL I worked at Ford Motor Company for 16 year on, among other things, Hydrogen Fuel Cell Vehicles.

Innovation has always been an important part of the automotive industry, but today the rate of change is faster than ever. There are technologies on the horizon that promise a future with cars that don't crash, that don't damage the environment and that create new business opportunities we couldn't have imagined just a few years ago.

The Department of Energy and the national labs are working on technologies to help make this future a reality. Today I will tell you about just a few of the many ways the national labs are helping the automotive industry meet these goals while continuing to be the engine of our economy.

Connected and automated vehicles are all over the news. They are generally presented in the context safety and convenience, but they will also have a big impact on energy and emissions. A group of researchers, at NREL and other national labs, are starting to quantify these impacts.

One example of research in this area is NREL's "Connected Traveler" project. This is an ARPA-E funded project with the goal to develop algorithms to understand a traveler's preferences, so that tailored recommendations and incentives can be provided to the individual traveler, using real-time data, so they can make better transportation decisions.

It's clear that Big-data and cyber-security are going to be increasingly important to the automotive industry. The national labs have significant expertise and capabilities in these areas.

The labs are also doing a lot of work to accelerate the development and of deployment of electrified vehicles. We are using our expertise in Li-Ion batteries, high performance computing, and simulation to help the automotive industry shorten design time and improve the performance of automotive batteries. One example is our CAEBAT project to develop new computer aided engineering tools for battery development.

Wide bandgap semiconductor materials will make power electronic devices smaller, more efficient, and able to operate at higher temperatures. For electric vehicles this means more efficient vehicles and charging stations. PowerAmerica, sponsored by the DOE, is bringing together industry partners, universities and national labs to accelerate the development and commercialization of these devices.

Electric vehicles are part of the every expanding Internet of Things. At NREL we examine the interaction of building energy systems, utility grids, renewable energy sources, and electric vehicles. We have world-class facilities including the Energy Systems Integration Facility and the Vehicle Technology Integration Facility to study these interactions.

Fuel cell electric vehicles are now commercially available. This is made possible by more than a decade of innovation, supported by the Fuel Cell Technologies Office, resulting in a more than 50% decrease in the cost of fuel cell systems. This is fantastic, but there are still significant challenges to be met including cost-effective generation of renewable hydrogen and development of a robust hydrogen-fueling infrastructure. NREL is a world leader in renewable hydrogen production. We are also partners in H2FIRST, a collaboration with Sandia National Lab, that is working with industry partners to find innovative solutions to hydrogen infrastructure problems.

Internal combustion engines will continue to be an essential part of the transportation system, particular for heavy-duty transportation. Groundbreaking research over the past 10 years has identified new combustion engine strategies that, when optimized to run on renewable fuels, offer significantly higher efficiency and lower emissions. The DOE has launched an initiative coordinating the efforts of researchers across the national lab system to work on the co-optimization of fuels and engines.

Replacing heavy steel components with components made of lighter metals, plastics, or composites, can reduce vehicle mass by up to 20%, resulting in a 12%–16% reduction in fuel consumption and GHG emissions. The Institute for Advanced Composites Manufacturing and Innovation, supported by the DOE's Advance Manufacturing Office, is working to develop new low-cost, high-speed, and efficient manufacturing and recycling process technologies for advanced polymer composites.

In conclusion, there is range of research underway that will achieve many benefits for the nation's transportation system including improving energy efficiency, reducing environmental impact, and driving U.S. Competitiveness. These are exciting times.

Thank you, I would be happy to address any questions.